

## SECTION 16080

### ELECTRICAL ACCEPTANCE TESTING

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#### **LANL MASTER CONSTRUCTION SPECIFICATION**

Edit specification to suit Project. Add job-specific requirements; delete only those portions that do not apply to the Project (e.g., a component that does not apply). To seek a variance from applicable requirements, contact the Engineering Standards Manual (ESM) Electrical POC. Refer to [http://www.lanl.gov/f6stds/pubf6stds/engrman/HTML/poc\\_techcom1.htm](http://www.lanl.gov/f6stds/pubf6stds/engrman/HTML/poc_techcom1.htm) for the Engineering Standards Manual Personnel Link Index.

When assembling a specification package, include applicable specifications from all Divisions, especially Division 1, General Requirements.

Delete information within "stars" during editing.

Specification developed for ML-3 / ML-4 projects. For ML-1 / ML-2, additional requirements and QA reviews are required.

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A "small project" is defined as one that DOES NOT include complex equipment such as unit substations or large motor control centers. The electrical testing agency (ETA) for a small project can be either the LANL Support Services Subcontractor or a qualified electrical testing firm. LANL Support Services Subcontractor personnel must have the specified qualifications.

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#### **PART 1 GENERAL**

##### **1.1 SECTION INCLUDES**

A. Provide the services of a qualified electrical testing agency (ETA) to perform the functions described below:

1. Perform acceptance tests, inspections, and calibrations of certain electrical systems, equipment, and material installed under the scope of this Project; refer to Part 3 of this Section.
2. Perform system function tests after completion of acceptance tests on certain electrical systems, equipment, and material installed under the scope of this Project.

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Edit the following paragraphs to suit project requirements; delete if not needed. Coordinate with the ESM Chapter 7 POC. Safety class and safety significant systems on small projects will require more extensive power system studies.

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3. Perform the following power system studies based on the installed electrical system and equipment:

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Preliminary fault current study is performed by the design agency for projects during definitive design. Final fault current study is typically not required for a small project.

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- a. Final short circuit study

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**Preliminary coordination current study is performed by the design agency for projects during definitive design. Final coordination study is typically not required for a small project.**  
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b. Final coordination study

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**Load flow analysis is required for complex electrical distribution systems with multiple sources and/or parallel circuit paths. Load flow analysis is typically not required for a small project.**  
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c. Load flow analysis study

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**Stability analysis is required for electrical distribution systems with on-site co-generation and/or large synchronous motors. Stability study is typically not required for a small project.**  
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d. Stability study

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**Harmonic analysis is required for electrical distribution systems with harmonic generating non-linear loads (UPS, adjustable frequency drive, power converter, etc.) constituting the majority of the connected load.**  
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e. Harmonic analysis study.

## 1.2 REGULATORY REQUIREMENTS

- A. The ETA shall make inspections and tests in accordance with the applicable codes and standards of the following agencies except as provided otherwise herein:
  - 1. InterNational Electrical Testing Association - NETA ATS-[current edition], *Acceptance Testing Specifications* (ANSI). NETA-ATS forms a part of this specification to the extent referenced.
  - 2. National Fire Protection Association – NFPA
    - a. NFPA 70: National Electrical Code (ANSI)
    - b. NFPA 70B: Recommended Practice for Electrical Equipment Maintenance (ANSI)
    - c. NFPA 70E: *Electrical Safety Requirements for Employee Workplaces* (ANSI).

## 1.3 QUALITY ASSURANCE

- A. The ETA shall be a corporately and financially-independent testing organization which shall function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of the equipment or systems to be evaluated.
- B. The ETA shall be a first tier subcontractor. No work required by this section of the specification shall be performed by a second tier subcontractor.
- C. The ETA shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.
- D. The ETA shall have a documented quality assurance program, documented inspection and test policies and procedures, and a documented electrical safety program.

- E. The ETA shall have successfully completed not less than five acceptance testing, inspection and calibration projects of similar scope to this project.
- F. The ETA shall have a calibration program, and test instruments used shall be calibrated in accordance with NETA ATS.
- G. Each person performing testing, inspection, calibration, and adjustments shall be a “qualified person” as defined by NFPA 70E and the NEC.
- H. Testing, inspection, calibration, and adjustments shall be performed or supervised on the Project site by an ETA employee having the following minimum qualifications:
  - 1. A minimum of 5 years' experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices, and
  - 2. Either an engineering technician certified to at least Level III in accordance with ANSI/NETA ETT-[current edition] – *Standard for Certification of Electrical Testing Technicians* (ANSI), or a registered professional electrical engineer.

#### 1.4 LANL PERFORMED WORK

- A. None

#### 1.5 SUBMITTALS

- A. Submit the following in accordance with [Section 01330 Submittal Procedures](#):
  - 1. Certifications: Submit name and qualifications of the ETA.
  - 2. Certifications: Submit quality assurance program of the ETA.
  - 3. Certifications: Submit instrument calibration program of the ETA.
  - 4. Certifications: Submit electrical safety program of the ETA.
  - 5. Certifications: Submit name and qualifications of the lead engineer or engineering technician performing the required testing services. Include a list of three comparable jobs performed by the individual with specific names and telephone numbers for reference.
  - 6. Test Reports: Submit acceptance and system function test procedures for each item of equipment or system to be field tested at least 45 days prior to planned testing date. Do not perform testing until test procedures have been approved.
  - 7. Test Reports: Submit certified copies of inspection reports, test reports, and system function tests. Reports shall include certification of compliance with specified requirements including test instrument calibration, identification of deficiencies, and recommendation of corrective action when appropriate. Type and neatly bind test reports to form a part of the final record. Submit test reports documenting the results of each test not more than 10 days after test is completed.

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**Edit the following paragraphs to suit project requirements; delete if not needed. Refer to the power system descriptions in clause 1.1.**  
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8. Calculations: Submit certified copies of power system studies listed below. Calculations shall include certification of compliance with specified requirements, identify deficiencies, and recommend corrective action when appropriate. Type and neatly bind Calculations to form a part of the final record. Submit power system studies in paper format and also in electronic format transmitted on a CD-ROM.
  - a. Final short circuit study
  - b. Final coordination study
  - c. Load flow study
  - d. Stability study
  - e. Harmonic analysis

## PART 2 PRODUCTS

Not Applicable

## PART 3 EXECUTION

### 3.1 GENERAL

- A. Perform the installation insulation-resistance, continuity, and rotation tests for electrical equipment described in each Section of these Specifications before, and in addition to, tests performed by the ETA that are specified in this Section.
- B. Supply a suitable and stable source of electrical power to each test site.
- C. Schedule the project to allow adequate time for electrical acceptance testing BEFORE equipment or system is energized. Notify the ETA when equipment becomes available for acceptance inspections and tests. Coordinate work to expedite inspections and tests.
- D. Supply one set of the following to ETA prior to the performance of any final testing:
  1. Preliminary short-circuit analysis
  2. Preliminary coordination study and protective device setting table
  3. Complete set of electrical Drawings, Specifications, and any pertinent Change Orders
  4. Approved construction submittal documents for material, equipment, or system
  5. Other information necessary for an accurate test and inspection of the system.
- E. Notify Contract Administrator at least 14 days in advance of when tests will be conducted by the ETA. Notify Contract Administrator or the University Technical Representative (UTR) again approximately 24 hours before commencement of testing. If requested by the Contract Administrator, the UTR will witness tests and inspections.

### 3.2 INSPECTION AND TEST PROCEDURES

- A. The ETA shall perform the acceptance tests and inspections.
- B. The ETA shall use test methods, follow procedures, and evaluate test values in accordance with NETA ATS, the manufacturer's recommendations, and each applicable specification section.
- C. Tests identified as optional in NETA ATS are not required unless otherwise specified.
- D. Place equipment in service only after completion of required tests and evaluation of the test results.
- E. The ETA shall Perform acceptance tests and inspections on equipment and systems specified in the following sections:

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**Edit the following paragraphs to match Project requirements and the construction specifications for the Project. Delete specification sections for equipment/systems not included in the Project. Add specification sections for equipment/systems on the Project for which NETA-ATS has a test/inspection procedure. Note any of the NETA-ETS optional inspections/tests that may be necessitated by Project conditions.**

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#### 1. Section 16120 – Building Wire and Cable

- a. Test building wire using the graded approach indicated in the following table:

Conductor Type	ML-1 System					ML-2 System Security System Life Safety System					ML-3 System ML-4 System				
	Service	Feeder	Branch ≥6 AWG	Branch <6 AWG	Control ≥ 120V	Service	Feeder	Branch ≥6 AWG	Branch <6 AWG	Control ≥ 120V	Service	Feeder	Branch ≥6 AWG	Branch <6 AWG	Control ≥ 120V
Inspection or Test															
Compare conductor data with drawings and specifications	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Inspect for physical damage and correct connections.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Inspect bolted connections for high resistance.	X	X	X	X		X	X	X	X		X	X	X	X	
Inspect compression applied connections for correct cable match and indentation.	X	X				X	X				X	X			
Inspect for correct identification and arrangements.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Inspect jacket insulation.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Test bolted connections for high resistance using low-resistance ohmmeter.	X	X	X	X		X	X	X	X		X	X	X	X	
Perform insulation-resistance test on each conductor to ground and other conductors.	X	X	X	X	X	X	X	X	X	X	X	X	X		
Perform continuity tests to insure correct connections.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Verify uniform resistance of parallel conductors.	X	X				X	X								

#### 2. Section 16215 – Metering

- a. Verify correct polarity and connection of instrument transformers.

3. Section 16225 – Motors
  - a. Test motors rated 5 hp and greater.
  - b. Perform vibration baseline test for motors rated 10 hp and larger.
4. Section 16269 – VFD Controllers
5. Section 16410 – Enclosed Switches and Circuit Breakers
6. Section 16420 – Enclosed Controllers
  - a. Verify that motor overload protection is appropriate for the application.
7. Section 16426 – Low-Voltage Power Circuit Breaker Switchgear
8. Section 16450 Secondary Grounding
9. Section 16460 – Dry-Type Transformers
10. Section 16470 Panelboards
  - a. Test panelboard main circuit breakers.
  - b. Test molded case circuit breakers rated 150 amps and greater.
11. Section 16482 – Motor Control Centers

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**Edit the following paragraphs to match Project requirements and the construction specifications for the Project.**  
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- F. Tests and inspections on the following equipment and systems will be performed by either the installing firm or the University and are excluded from the scope of this Section:
1. Addressable fire alarm system
  2. Medium-voltage power cable
  3. Pad-mounted medium-voltage switchgear
  4. Pad-mounted transformer with medium-voltage primary
  5. Lightning protection system
  6. Telecommunications system
  7. Administrative access control system
  8. Security system
  9. Voice paging system
  10. Instrumentation and controls systems

11. Engine-generator prime mover.

### 3.3 SYSTEM FUNCTION TESTS

- A. The ETA shall develop and perform system function tests in accordance with NETA ATS after completion of acceptance inspections and tests.

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**Edit the following article to suit project requirements. Delete if not required.**

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### 3.4 THERMOGRAPHIC SURVEY

- A. The ETA shall perform system thermographic survey of current-carrying devices rated 800 amperes and greater in accordance with NETA ATS.

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**Edit the following article to suit project requirements. Refer to the power system descriptions in clause 1.1.**

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### 3.5 POWER SYSTEM STUDIES

- A. The ETA shall provide power system studies listed below based on the installed electrical distribution system and equipment.
1. Short-circuit study. Calculate the short-circuit momentary and interrupting duty on the basis of maximum available fault current at each bus in the distribution system down to the following points in the low-voltage system:
    - a. 480 volt system where available short circuit current is less than 14,000 amperes RMS symmetrical.
    - b. 208 or 240 volt system where available short circuit current is less than 10,000 amperes RMS symmetrical.
  2. Coordination study. Include in the coordination study all voltage classes of equipment from the utilities incoming line protective device down to and including each low voltage load protective rated 100 amperes and larger.
  3. Load flow study
  4. Stability study
  5. Harmonic analysis study
- B. The ETA shall perform power system studies in accordance with procedures described in NETA-ATS and the referenced codes and standards.
1. Include in the study the effect of all portions of the electrical distribution system including alternate sources of power.
  2. Address normal system operating configuration plus any plausible alternate configurations and operations that could result in maximum fault condition.

### 3.6 FIELD QUALITY CONTROL

- A. Report to the Contract Administrator, within three working days, any system, material, equipment or construction that is found defective based on acceptance tests or inspections by the ETA.
- B. Within 15 days of direction from the Contract Administrator, rework, repair or replace any system, material, equipment or construction that is found defective based on acceptance tests or inspections.
- C. Retest any system, material, equipment or construction that did not pass acceptance tests or inspections.

END OF SECTION

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**Do not delete the following reference information.**

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FOR LANL USE ONLY

This project specification is based on LANL Master Construction Specification Section 16980 Rev. 0, dated April 13, 2004.